AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 6. No 05. MAY ,2026

MECHANISMS OF FORMATION AND MORPHOLOGICAL FEATURES OF INJURIES TO THE SCALP CAUSED BY SHARP AND BLUNT OBJECTS

Nuridinov Azim Kamolidinovich

Assistant at the Department of Forensic Medicine and Medical Law,

Tashkent State Medical University

https://doi.org/10.5281/zenodo.20142621

Abstract: The article presents the results of an experimental forensic medical study of the formation mechanisms and morphological features of injuries to the scalp caused by sharp and blunt objects. Experimental modeling was conducted using a Charpy pendulum impact tester at standardized values of kinetic energy. The study examined the features of wound formation, the properties of their edges, ends, and walls, as well as morphological changes in the hair and hair follicles. It was established that the morphology of injuries depends on the magnitude of the kinetic energy, the degree of blade sharpness, and the characteristics of the trace contact between the traumatizing object and the barrier. The results obtained are of great importance for the forensic medical diagnosis of the injury mechanism and the identification of the injuring weapon.

Keywords: forensic medicine, chop wounds, scalp, axe, kinetic energy, morphogenesis, traceology, stereomicroscopy, mechanism of injury.

Introduction: Injuries to the scalp constitute a significant portion of the mechanical trauma investigated in forensic medical practice. Chop injuries caused by sharp and blunt objects present a particular challenge, as their morphological features often resemble both incised and contused-lacerated wounds.

Forensic assessment of such injuries requires a detailed study of their formation mechanisms, trace contact features, and the morphological signs of the wounds. The shape of the wounds, the condition of their edges, the presence of abrasions, connective tissue bridges, and the nature of the damage to the hair and hair follicles are of significant diagnostic value.

Despite a considerable number of studies on chop injuries, issues concerning the influence of kinetic energy and the specific movement of the traumatizing object on wound morphology remain insufficiently studied. In this regard, conducting experimental research using standardized modeling is of significant scientific and practical interest.

The aim of the study is to investigate the mechanisms of formation and morphological features of injuries to the scalp caused by sharp and blunt objects, as well as to determine their forensic diagnostic significance.

Materials and Methods: Experimental modeling of the impact of a sharp-bladed axe was conducted on a Charpy pendulum impact tester. The blow was delivered with the middle part of the axe blade along an arc-shaped trajectory, perpendicular to the spherical surface of a wooden mannequin simulating the human cranial vault.

The mannequin was placed on a flat surface in an unfixed position. The length of the pendulum arm corresponded to the average length of a human arm holding an axe handle.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 05. MAY ,2026

The modeling process was recorded by a digital video camera, with subsequent frame-by-frame analysis of the video recording to examine the stages of trace contact.

The following methods were used to investigate the injuries:

• visual inspection;

• morphometric analysis;

• stereomicroscopy;

• traceological analysis;

• photography of the injuries.

Results: Under an impact with a kinetic energy of 9 J, the sharp-bladed axe, moving along an arc-shaped trajectory, made superficial contact with the spherical surface of the mannequin. Part of the energy was expended on the progressive movement of the mannequin, which was displaced forward by approximately 5 cm and upward by 0.5 cm.

The wounds had:

• a linear shape;

• a penetrating or non-penetrating character;

• a length ranging from 42 to 64 mm on the outer surface of the skin.

The average wound length was 54.8 mm.

The wound edges were predominantly smooth; however, fine serration was observed in the "nasal" third. The abrasion was marginal and intermittent and was most pronounced in the terminal sections of the wounds.

The ends of the wounds were nearly acute-angled and contained:

• tissue bridges;

• "bridges" of uncut hair;

• thin connective tissue strands.

The wound walls were predominantly perpendicular and fine-grained, and at the level of the aponeurosis, they were nodular.

Morphological changes in hair:
The study of hair in the damaged areas showed the high informational value of its morphological changes.
The following was established:
• transverse and oblique transection of hairs;
• oval shape of the shaft ends;
• finely serrated separation surface;

AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 6. No 05. MAY ,2026

• deformation of the hair bulbs.

Some of the hairs had:

• flattened sheaths;

• symmetrical and asymmetrical triangular bulbs;

• bends toward the "heel" end of the wound.

In some cases, the hairs remained untransected and formed distinctive "bridges" between the wound walls.

When impacted with a kinetic energy of 19.3 J, the axe penetrated the mannequin's surface significantly deeper. The mannequin was displaced:

• 8 cm forward;

• 2 cm upward.

During the interaction, the primary contact zone shifted from the middle part of the blade to its "toe" due to slippage.

The wounds were:

• through-and-through;

• linear in shape;

• from 76 to 82 mm in length.

The average length was 79.8 mm.

Abrasion was noted along almost the entire length of the wounds and was most pronounced in the middle and "heel" thirds.

On the wound edges, the following were detected:

• areas of epidermal depression;

• transverse folding;

• local areas of skin flattening.

The wound walls were predominantly perpendicular, and in some places sloped toward the more pronounced abrasion.

Conclusion: This experimental study established the patterns of injury formation to the scalp caused by sharp objects.

It was found that:

• wound morphology depends on the magnitude of kinetic energy;

• the features of the wound edges and ends have high diagnostic value;

• changes in hair and hair bulbs reflect the mechanism of trace formation;

• tissue bridges are an important identifying feature of chop wounds.

The data obtained are of significant importance for forensic medical practice in reconstructing the circumstances of an injury and identifying the injuring object.

References

1. Алимов Ҳ.А. Суд тиббиёти. — Тошкент: Ўзбекистон миллий энциклопедияси, 2019. — 520 б.

2. Попов В.Л. Судебная медицина. — Санкт-Петербург: Питер, 2018. — 608 с.

3. Пиголкин Ю.И., Дубровин И.А. Судебно-медицинская травматология. — Москва: ГЭОТАР-Медиа, 2020. — 432 с.

4. DiMaio V.J.M., DiMaio D. *Forensic Pathology*. — 3rd ed. — Boca Raton: CRC Press, 2021. — 680 p.

5. Saukko P., Knight B. *Knight's Forensic Pathology*. — 4th ed. — London: CRC Press, 2016. — 768 p.

6. Spitz W.U., Spitz D.J. *Spitz and Fisher's Medicolegal Investigation of Death*. — 5th ed. — Springfield: Charles C Thomas Publisher, 2020. — 896 p.

7. Madea B. *Handbook of Forensic Medicine*. — Oxford: Wiley-Blackwell, 2014. — 1312 p.

8. Shkrum M.J., Ramsay D.A. *Forensic Pathology of Trauma*. — Totowa: Humana Press, 2007. — 704 p.

9. Adelson L. *The Pathology of Homicide*. — Springfield: Charles C Thomas Publisher, 1974. — 928 p.

10. Prahlow J.A. *Forensic Pathology for Police, Death Investigators, Attorneys and Forensic Scientists*. — New York: Humana Press, 2010. — 896 p.

11. Karger B., Brinkmann B. Mechanical Injuries and Wound Ballistics in Forensic Medicine // *Forensic Science International*. — 2018. — Vol. 287. — P. 1–12.

12. Pollak S. Sharp Force Injuries and Their Forensic Interpretation // *Forensic Science, Medicine and Pathology*. — 2015. — Vol. 11, №2. — P. 147–156.

13. Symes S.A., Rainwater C.W., Chapman E.N. Knife and Sharp Force Trauma: Classification and Interpretation // *Journal of Forensic Sciences*. — 2012. — Vol. 57, №3. — P. 709–718.

14. Jason D.R. Interpretation of Blunt and Sharp Force Injury Patterns // *Academic Forensic Pathology*. — 2014. — Vol. 4, №1. — P. 35–44.

15. Oehmichen M., Meissner C. Atlas of Blunt and Sharp Force Injuries // *Forensic Science International*. — 2010. — Vol. 199, №1–3. — P. 1–8.

16. Brinkmann B. Forensic Biomechanics of Head Injuries // *International Journal of Legal Medicine*. — 2017. — Vol. 131, №4. — P. 1023–1035.

17. Karpov D.A., Sarkisyan B.A. Morphological Characteristics of Chop Wounds Produced by Sharp and Blunt Edges // *Sudebno-Meditsinskaya Ekspertiza*. — 2001. — Vol. 44, №5. — P. 12–16.

18. Саркисян Б.А., Карпов Д.А. Экспериментальное моделирование механических повреждений кожи. — Москва: Медицина, 2005. — 248 с.

19. Ratnevsky A.N. Methods of Restoration and Examination of Damaged Skin Preparations in Forensic Medicine // *Sudebno-Meditsinskaya Ekspertiza*. — 1972. — №4. — P. 18–22.

20. Madea B., Musshoff F. Interpretation of Sharp and Blunt Force Trauma in Forensic Practice // *International Journal of Legal Medicine*. — 2016. — Vol. 130, №3. — P. 719–730.

21. Gordon I., Shapiro H.A., Berson S.D. *Forensic Medicine: A Guide to Principles*. — Edinburgh: Churchill Livingstone, 1988. — 512 p.

22. Vij K. *Textbook of Forensic Medicine and Toxicology*. — 6th ed. — New Delhi: Elsevier, 2014. — 712 p.

23. Payne-James J., Busuttil A., Smock W. *Forensic Medicine: Clinical and Pathological Aspects*. — London: Greenwich Medical Media, 2003. — 832 p.

24. Dettmeyer R. *Forensic Histopathology: Fundamentals and Perspectives*. — Berlin: Springer, 2011. — 389 p.